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LOCO WEED AND LOCO POISON.

By L. E. SAYRE, University of Kansas, Lawrence.

BY REFERRING to the Sixth Biennial Report of the Kansas Board of Agriculture, page 147, and other publications by this department, it will be noted that the investigation of the poisonous qualities of the loco weeds was inaugurated in 1886 by the above board, under direction of the writer. The geographical distribution of the plant in the state and bordering states, the description of the various species of loco plants, and a chemical examination of these, were made and reported upon.

As all of the various physiological symptoms produced by the loco were reported as caused by opium or some such vegetable poison, everyone felt pretty sure that the so-called loco poison must be that of a *vegetable toxic principle*, somewhat akin to that of morphine or to that of any of the numerous narcotic alkaloidal poisons. A thorough analysis of the loco plants, however, proved conclusively that such a vegetable poison did not exist. However, it was shown that minute quantities of an alkaloid existed in the plant, but not in sufficient quantity to account for the reputed action of the loco upon stock. The cause of the poisonous action of the drug was therefore an enigma. A medical writer, speaking of the mystery of the problem, says: "The disease called loco is as murky as was milk sickness, so prevalent in Indiana and Kentucky in early days."¹ Loco plants, it was finally conceded, were poisonous to animals, but were without action upon human beings. "So far as I can learn," the above writer adds, "it neither impresses the human being therapeutically nor is possessed of any remarkable physiological power, and as an active physiological agent it has passed silently into oblivion."

The writer never ceased to regard the subject of loco poisoning as one of the greatest importance to the farmer and ranchman, and made continuous effort to keep the subject before scientists, in the hope that others would join in the investigation. Quoting from the Sixth Biennial Report, page 147, it was observed: "It might seem a very easy matter to reach a conclusion upon this subject, which is of such vital interest to the farmer and ranchman of the West, but to do this and satisfy the demands of science it re-

1. Eclectic Med. Journal, Oct., 1893, page 482.

quires not only careful physiological and chemical investigations of a peculiar and delicate kind, but the closest and long-continued observation. We have had hearsay evidence enough on this subject, and now we need to go at it in earnest, in a way that will be recognized by scientific men, and investigations should be pushed to the farthest limits without any short-sighted regard for the cost." It was further urged that experimental work upon the field was necessary for the final settlement of the question of loco poisoning.

In the year of 1905 the United States government took up the investigation of loco in a very elaborate manner. A feeding station was located at Hugo, Colo., under the general direction of Dr. Rodney H. True, of the Bureau of Plant Industry, placing the station under the immediate supervision of C. Dwight Marsh. At the same time that this field work was in progress, pharmaceutical experiments upon animals, using the concentrated extract of the plant upon them, were conducted in the laboratories of the Bureau of Animal Industry by Dr. A. C. Crawford. As the works of these two scientists are now completed, it is well to refer to their classic reports, published by the Bureau of Plant Industry (Bulletins Nos. 112 and 129 of the Bureau of Animal Industry). It would be impossible to give a résumé of these two bulletins, but a sufficient number of extracts from these publications may suffice.

Crawford found by his experiments upon rabbits that "concentrated aqueous extracts of the drug induced death." A series of records are made showing that rabbits were killed after administering the extracts in various ways, by subcutaneous injections, etc. In summing up his experiments upon rabbits, he says: "The experiments indicate that an acute form of poisoning may be induced by feeding concentrated extracts of *Astragalus mollissimus* and *Aragallus lamberti*, from Hugo, Colo., and Imperial, Neb., to rabbits, and that if the extract be given in smaller and repeated doses a more prolonged and chronic condition will follow. The rabbits showing the chronic effects of these plants exhibit symptoms which have a marked parallelism with those reported as occurring in larger herbivora (horses and cattle) on the range when locoed; that is, the loss of appetite, the emaciation and loss of weight, the dullness and stupor, with more or less anesthesia, the disturbance in the visual function, and the mental symptoms. The occasional abortion compares with what has been observed in larger animals. The dried *Astragalus mollissimus* and *Aragallus lamberti* still retained their poisonous properties. Aqueous extracts of the dried

plants, made in the laboratory under the proper conditions, produced fatal effects. But what was the nature of the poison? It had been proven a nonvegetable substance. What other poison could a vegetable secrete?"

Chemical experiments conducted along with the pharmacological experiments of Marsh and Crawford resulted in a very important discovery, namely, that if the ashed plant was extracted with sulphuric acid the *solution proved inactive to rabbits*. In other words, the substance removed by the use of sulphuric acid seemed to be the active material. Such a reaction would point to one of a group of important substances which a plant would be liable to assimilate. Accidentally, Crawford found that Spengel had reported the presence of barium in one of the species of *astragalus*, a closely allied plant to the loco, and also found recorded in chemical literature that barium had been found in a number of other plants by other chemists. Guided by this indication pointing to a solution of the problem, and having well-grounded suspicions that the cause of the poison might be after all an inorganic poison, and having suspected barium as the inorganic element, feeding experiments with barium were conducted upon animals in the laboratories. These were accompanied with positive results. It was found, for example, that one gram of barium carbonate would kill a dog in eight hours. It may well be stated in passing that it is well known that barium carbonate has been employed as a rat poison, and its toxic qualities upon lower animals have been well established. Recently the high toxicity of barium has been recognized by a writer on pharmacology. The peculiar effect of its salts upon the circulation, upon the heart, upon the nervous system and upon the blood pressure are symptoms giving evidence of this; and if barium is contained in the soil and is absorbed by the plants, the plants ingested and the barium content assimilated in the circulatory system, it would produce, very gradually, the symptoms recognized as the loco disease. But the physiological action of this inorganic element was thoroughly worked out (for the first time) by Crawford in the pharmacological laboratory, and the connection with it and loco well established—and thus the mystery of the loco poisoning seems to be finally solved. The work of Marsh and Crawford is by far one of the most important issuing from the laboratories of plant and animal industry, located in Washington.

One of the mysteries connected with the problem was that loco in certain pastures was nontoxic. This phenomenon has also been accounted for by the above investigation. It has been shown by

experiment that if loco plants are grown upon certain soils—soils that contain no barium—these plants are not poisonous or are pharmacologically inactive. This solves that mystery which confronted ranchmen and farmers. In the present writer's early reports it was stated that very contradictory testimony was obtained from ranchmen of different localities, some stating positively that loco weed was not poisonous, while others stated, on the contrary, that it was deadly poisonous. Many observers in the western part of Kansas stated that where the loco plant grows abundantly it had no deleterious effect upon animals. This can now, in the light of the Crawford and Marsh investigations, be accounted for by the fact that the soil of that particular region contains no barium.

It will be seen at once that this investigation has been of value, and opens up a field considerably wider than first anticipated. In our laboratory at the University of Kansas, since Crawford's report, we have collected numerous plants upon which cattle are likely to feed, and have subjected these to artificial digestion in an artificial gastric fluid. This fluid is prepared by employing an active pepsin and acidulated water. These experiments have been conducted, under our supervision, by Mr. James T. B. Bowles. We shall at present confine ourselves to laboratory experiments upon loco weed.